APPENDIX B

NRC RESPONSE TO SIGNIFICANT RADIOLOGICAL OCCURRENCES AND OPERATIONAL EVENTS

INTRODUCTION

The NRC response to significant radiological occurrences and operational events at the Haddam Neck site is discussed in this portion of the report. The team first reviewed the licensee's reports to determine what was known by the licensee and what was reported to the NRC. After the scope and extent of the history were determined, the team reviewed NRC inspection reports and licensee correspondence to determine the NRC response to the occurrences and events. A short section is included to define the general standards and guidelines used by the NRC inspectors for response to these types of occurrences and events.

1. LICENSEE REPORTING OF RADIOLOGICAL EVENTS

Scope

In an effort to understand the scope and extent of the history at Haddam Neck related to spills and contamination, the team reviewed the licensee's internal and external reports and notifications regarding events in the areas of radiological spills/releases, problems with stainless steel fuel cladding, radioactive waste system occurrences and release of potentially contaminated materials from the facility. The documents covered the period from 1967 to present, with an emphasis on reports required by 10 CFR 50.73.

Details

1.1 Internal Plant Reports

The licensee used the Plant Information Report (PIR) system, and later, the Adverse Condition Report (ACR) system, as an internal reporting system to identify and track any condition in the plant that required follow up or corrective action. In addition to plant operational events, the systems were also used to document spills and unplanned releases to the environment.

PIRs and ACRs related to potential contamination events were assembled by the licensee for its own review to aid in the site characterization for decommissioning planning/preparation. The recently assembled documents covered the period from 1967 to present and were made available to the NRC team. Events, releases and spills were recorded for the entire operating period of the plant, from start-up through the time of shutdown. Major events had significantly more detail written in each report. The reports generally reflected the information included in NRC Region I Inspection Reports. There were no events in NRC Inspection Reports that were not captured in the licensee's internal reporting system with

the exception of some noble gas releases that had minor dose consequence. A list of the radiological spills or releases to the environment that were identified in either the licensee's internal or external reports are summarized in the Chronological Listing of Events and NRC Response (Supplement B-1 to this report). This information references the NRC inspection reports(s) in response to specific incidents and denotes if an agency enforcement action was taken.

1.2 External Notifications and Reports

A review of all Haddam Neck Abnormal Occurrence Reports (AORs) from 1967 through 1975 and all Licensee Event Report (LERs) from 1976 through 1997 was conducted. Those reports pertaining to releases, spills, abnormal radiological control practices or radiation monitoring deficiencies are listed in the event summary (Supplement B-1). Most of the LERs were not associated with radioactive releases or spills of radioactive materials. Ten reports described on-site spills of liquid radioactivity that contaminated areas of the site inside the protected area fence. These contaminated areas were subsequently decontaminated. Twelve reports described unplanned offsite releases of gaseous radioactivity.

The LER notification system took effect in 1976. Prior to 1976, the licensee submitted AORs informing the NRC of events not in conformance with its Technical Specifications. In general, the quality of AORs and LERs varied until the LER reporting rule (10 CFR 50.73) became effective in 1984. The purpose of the rule was to eliminate reporting events of low safety significance and to require more thorough documentation and analyses of reported events. The rule requires the licensee to report to the NRC within 30 days after any event that meets the criteria.

Approximately 650 AORs or LERs have been written for Haddam Neck since the start of commercial operation in the late 1960s. From the start of the plant until the LER rule became effective in 1984, Haddam Neck wrote relatively fewer AORs and LERs than its industry peers on a per operating unit basis. The reports often lacked detailed root cause analyses and offered few follow-up actions. When the LER Rule came into effect in 1984, the overall quality of the reports improved. Better root cause determinations were provided and corrective actions were more inclusive. A detailed evaluation of the safety significance of a particular event is included in all LERs submitted after 1984 which means, for events involving releases of radioactive materials, that dose assessments to the public were evaluated. For the remainder of the 1980s, Haddam Neck submitted an average of 30 LERs each year which was comparable to the average of 28 issued by its peers in the industry. However, in 1986, 48 reports were submitted to the NRC, an abnormally high number compared to the industry average. In the 1990s, Haddam Neck had issued an average of 26 LERs each year, which is nearly twice the industry average of 14 LERs over the same time period.

Corrective actions were not always immediately effective nor timely to prevent recurrence. For example, there were four separate reports between June 1976 and February 1980 describing leakage from the radwaste discharge pipe which contaminated the sand beneath some on-site asphalt. The licensee's initial follow up was not entirely effective. Four years passed before the licensee ultimately corrected the problem. After each of these

occurrences, the licensee excavated the contaminated sand and shipped it to an authorized radioactive burial facility.

Between March 1976 and September 1977, there were three instances of Waste Gas Decay Tank rupture disc actuation resulting in the release of 19 curies of noble gases to the environment. These disc actuations were a result of a field change to the design of the system when it was installed in 1975. A system modification was completed in 1977 shortly after the third failure. The modification reduced the problem but did not return the system to the original approved design. Although unplanned, these releases were monitored and did not exceed NRC off-site dose limits for members of the public.

A number of reports indicate repetitive occurrences of releases or spills of radioactive material. Of particular note are the following:

- Unplanned Noble Gas Releases

  waste gas decay tank rupture disc actuation (11.6 Ci) LER 76-08
  waste gas decay tank rupture disc actuation (0.1 Ci) LER 76-15
  waste gas decay tank rupture disc actuation (7.4 Ci) LER 77-06
  degasifier rupture disc actuation (15.8 Ci) LER 79-06
  waste gas decay tank vent valve left open (19.7 Ci) LER 85-25

- Leaks in Radwaste Discharge Pipe Contaminate Underground Sand

  LER 76-13, LER 77-0, LER 78-03, LER 80-07

Although these repetitive events indicate a potential weakness by the licensee to adequately identify root causes and appropriate corrective actions, none of the reported releases exceeded NRC dose limits to members of the public in unrestricted areas.

Through the review of licensee documentation, the team did not identify any releases where the licensee failed to notify the NRC as required by regulations. The number of LERs regarding inadvertent releases of radioactive material (22) is small when compared to the total number of LERs (650) and the total number of radiological incidents (125) identified by the licensee in the historical review of the site. However, in most cases where the licensee had a radiological incident, a notification was not required by NRC regulations in 10 CFR 50.72 or 10 CFR 50.73. Although the criteria for reporting events has changed with revisions to 10 CFR 50, the team's review indicated that the licensee properly reported the events in accordance with the regulatory requirements in effect at the time. For instance, in 1989, contaminated liquid was released to a leach field outside the protected area fence through the storm drain system from the Spent Fuel Building. The licensee classified this unmonitored radioactive liquid release as an Unusual Event in accordance with its Emergency Plan and made a one-hour telephone call to the NRC pursuant to the requirements of 10 CFR 50.72. Because the drain system at Haddam Neck is not considered a safety system and the release did not result in concentrations in unrestricted areas greater than 20 times the applicable concentration limits, written notification (LER) was not required under 10 CFR 50.73 and an LER was not issued. Although LERs were not required by NRC

regulations for all radiological occurrences, the total radioactivity released was included in annual and semi-annual effluent reports as required for unmonitored or uncontrolled releases of radioactive material. Licensee effluent reports are reviewed by the NRC as part of the NRC core inspection program and the inspection reports document the acceptability of the licensee's effluent reports.

Conclusion

Haddam Neck reported an average number of licensee events during its commercial operating life when compared to the industry. Releases of radioactive material were reported as required. Reported releases did not exceed NRC limits to members of the public in unrestricted areas. Corrective actions were not always timely or effective to prevent recurrence. The team found that the licensee properly notified the NRC regarding radiological spills and inadvertent effluent releases.

2. NRC RESPONSE TO SIGNIFICANT EVENTS

Scope

The preliminary files for the 125 incidents that the licensee had identified in their Historical Site Assessment Data Table (Supplement A-1) were reviewed. Seventy incidents were evaluated by the team to determine the extent of NRC knowledge and response to these incidents (Supplement B-1). These 70 events were selected because there had been a notification to the NRC or the team believed the event could have an impact on the eventual decommissioning of the reactor site. The team reviewed approximately 600 inspection reports for the period from November 1967 through October 1997. The NRC Systematic Assessments of Licensee Performance (SALP) reports for Haddam Neck were reviewed to identify NRC awareness regarding overall licensee performance. The team also reviewed the NRC database regarding enforcement actions for Haddam Neck to determine what actions had been taken for the areas of interest within this report. In addition, the escalated enforcement history was reviewed for all other nuclear power reactor (Part 50) licensees in the United States to determine the type of enforcement taken in the areas of radiological effluents, radioactive material release, radioactive waste systems operation and fuel performance.

Details

2.1 General NRC Inspection and Event Follow-up Guidance

Routine NRC inspections were performed periodically since the start of operation at the Haddam Neck facility, with special inspections for significant events. In 1980, a resident inspector was assigned to each operating reactor site. The resident inspections increased the total inspection time at the site and covered a variety of areas, including plant operations, maintenance, engineering, radiation protection, security and follow-up to events. The resident inspection activities were supplemented by various specialist inspections in each major inspection area.

Specialist inspectors used various NRC Inspection Procedures (IPs) for guidance in a selected area of licensee activities (i.e., radiological controls). One major emphasis in NRC inspection procedures is a review of the effectiveness of the licensee's programs for radiation protection, radiological controls, radiological effluents, environmental monitoring, and radiological waste processing. There is limited guidance for radiological event response or NRC follow-up, including the review of the licensee's actions. The IPs used by a specialist inspector for a radiological event could include the following:

- IP 83750, titled "Occupational Radiation Exposure"
- IP 84750, titled "Radioactive Waste Treatment, and Effluent and Environmental Monitoring" and
- IP 83726, titled "Control of Radioactive Materials and Contamination, Surveys and Monitoring."

NRC IP 83726 provides guidance to inspectors in the area of radiological contamination controls. The current revision of the procedure for radioactive materials and contamination controls is very similar to the version used in the 1980s and puts emphasis on personal contaminations (skin or clothing), instruments and procedures for surveys and monitoring, proper clean-up of contamination (not specific to on-site or off-site) and reduction in volume of contaminated trash. The inspection procedure gives general guidance for reviewing the licensee's surveys, monitoring records and releases of potentially contaminated material to unrestricted areas. References include IE Bulletins, Circulars and Information Notices from 1980, 1981, 1985, and 1986. However, NRC Information Notice 88-22, "Disposal of Sludge from On-site Sewage Treatment Facilities at Nuclear Power Stations" is not referenced. This Information Notice discussed the need for licensees to perform radiation surveys of representative samples of materials under conditions that provide an LLD appropriate to measurements of environmental samples. NRC IP 83750 provides general guidance, similar to IP 83726, for inspectors in this topical area.

Effluent and environmental monitoring specialists use NRC IP 84750. This inspection procedure provides guidance for verifying dose commitments to the public from liquid and gaseous releases. With the exception of the verification on dose calculations, there is no other guidance on follow-up to a radiological event.

Based on the team's review of these NRC inspection procedures, there appears to be limited procedural guidance for inspectors to assess the adequacy of licensees' remediation efforts after a radiological event and the release of potentially contaminated volumetric materials from a licensed facility. Also, the responsibility for review of events involving licensed radioactive materials found outside the protected area is assigned on a case by case basis rather than being defined in NRC inspection guidance.

NRC inspections and event follow-up at Haddam Neck were performed in accordance with various inspection procedures. Inspection procedures provided general guidance for areas of review. Event reviews were principally focused on the consequences relative to applicable regulatory requirements regarding radioactive effluent or material released to the environment and personnel (worker) exposures. Other inspected areas, such as contamination events/decontamination efforts, which did not have a specific regulatory

requirement, were reviewed using accepted industry practices and generic radiological controls standards.

Other guidance that was available to NRC inspectors is contained in various NRC regulatory guides. NRC Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures and Components Installed in Light-Water-Cooled Nuclear Power Plants," contains guidance on how to control the release of radioactive materials in gaseous and liquid effluents and to handle radioactive solid waste during normal reactor operation, including anticipated operational occurrences. The guidance states that all tanks located outside reactor containment and containing radioactive materials in liquids should be designed to prevent uncontrolled releases of radioactive materials due to spillage in buildings or from outdoor tanks. The guidance further states that all tank overflows, drains and sample lines should be routed to the liquid radwaste treatment system. Indoor tanks should have curbs or elevated thresholds with floor drains routed to the liquid radwaste treatment system. The design should include provisions to prevent leakage from entering unmonitored and nonradioactive systems and ductwork in the area.

NRC regulations require that power reactor licensees monitor radioactive effluent releases and ensure that the radiation exposure to a member of the public from the releases be as low as is reasonably achievable. Guidance on how to implement these requirements is contained in Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I. The guide contains the basic calculational models and parameters for the estimation of radiation doses to man from significant radioactive effluent release pathways. The guide discusses that a pathway is considered significant if a conservative evaluation yields an additional dose increment equal to or more than 10 percent of the total from all pathways considered in Regulatory Guide 1.109. Therefore, the guidance states that monitoring is not required for liquid effluent pathways that would contribute less than 10% to the total annual exposure from all other liquid pathways. Also, an NRC health physics policy position (HPPOS-007) established in 1981 determined, based on the difficulties in monitoring radioactive discharge into storm sewer drains, the associated costs for installation and operation, general knowledge of past experiences with this particular type of unmonitored release from reactor operations and the small potential effect on public health, that requirements for monitoring storm sewer drains were unwarranted.

2.2 NRC Event Follow-up Inspection Reports

The review team developed a timeline that compares the events/incidents in NRC inspection reports and licensee reports (plant reports, LERS, etc.). The timeline is attached to this report as Supplement B-1. The time line indicates events that were reported by the licensee to the NRC and whether the events were documented by the NRC. It also indicates radiological events that resulted in NRC escalated enforcement. The inspection record indicates that the inspectors generally reviewed licensee event reports of spills or releases and associated licensee follow-up actions, worker contamination events, facility contamination status and decontamination efforts, and worker radiation exposures.

Typically, the licensee's documentation of unmonitored releases was reviewed as part of the routine NRC inspection of the environmental and effluent monitoring programs. To assess the significance of the event, inspectors reviewed documentation regarding the quantity of radioactive material released and the expected dose consequence from the release.

NRC inspectors started documenting the review of LERs for Haddam Neck around 1980. Until that time, very few AORs or LERs were documented in NRC inspection reports. The NRC staff generally documented most significant events or LERs that resulted in a potential release to the environment. However, there is not much detail written for most events. After 1990, a policy was implemented to track the review of all LERs so that each LER follow-up was identified in the inspection reports. This report requirement is included in the NRC Manual Chapter 0610, titled " Inspection Reports." The thoroughness of review and documentation regarding these events was dependent upon the significance of the LER and the extent of the inspector follow-up.

Although reported by the licensee to the NRC, some of the events at Haddam Neck were not addressed in NRC inspection reports. Even though the review team was unable to determine the reasons some events were not documented in NRC inspection reports, it was apparent that most events resulted in very low potential radiation exposures and had no safety consequence.

Based on the seventy selected events the following were not documented in NRC Reports:

- Improper waste discharge valve lineup in September 1977 caused 1400 gallons to go to the Spent Fuel Building Sump and then to the aerated drain tanks (radwaste system).

- High tritium background measurements in river water samples taken near the discharge canal in 1977 & 1978.

- Borated Water Storage Tank (BWST) heater leaked into the A & B heater wells and contaminated the in-house heating system (secondary system) in November 1978.

- Radioactive contamination found outside RCA but within the owner-controlled property in February 1981.

- 400 gallons of liquid radioactive waste (total activity of 3 microcuries) discharged from the radwaste test tank to the river due to valve mispositioning in December 1983.

- Various resin liner overflows in 1984 that resulted in local contamination on the site.

- Radiologically controlled area drains overflowed to the yard drain in March 1985.

- Broken drain line due to freezing on a temporary chemistry trailer in January 1986 that resulted in a small on-site contamination.

- Spill of component cooling water to a storm sewer in March 1990.

For the events that were documented, the review team found that larger spills/releases generally had thorough NRC review and follow-up regarding the licensee's corrective actions, but minor events had limited or no documented review. Most events were merely mentioned in inspection reports and no assessment was made of the licensee's corrective actions.

An evaluation of the inspection reports indicates that the NRC response to events at Haddam Neck varied. In particular, on-site contamination events often did not result in the use of a region-based specialist inspector. For example, trenching in the RCA in 1988 resulted in discovering contamination from a previous event in 1983. The licensee used a remediation level of 1E-4 microcuries/gram (µCi/g). Soil greater than this was treated as radioactive waste. However, it was not clear how the remaining soil was treated. Based on a review of the inspection reports, no specialist inspector evaluated the licensee's actions. In 1988, the licensee conducted an RCA refurbishment project. The NRC noted in the licensee's October 1988 Contamination Reduction Summary that many items within the RCA identified as waste had been either disposed of or released for unrestricted use. If the material was released, this value is a factor of 1000 higher than the existing NRC guidance (1 E-7 µCi/g) for an acceptable detection capability to detect the presence of license radioactive material prior to its release from a licensed site. Since no NRC follow-up item was identified, this issue was not re-examined by the NRC until the current site characterization activities.

Examples of NRC follow-up to significant events is outlined below:

- Degasifier event in 1979

  An event involving the release of steam and water to the plant stack was detailed in NRC Region I Inspection Report 50-213/79-21, dated February 20, 1980. Connecticut Yankee notified the Region I office at 4:45 PM on December 16, 1979, regarding an unplanned release earlier that day (5:45 AM) from the plant stack at Haddam Neck. The event happened during boron dilution operations and resulted in the venting of approximately 800 gallons of water/steam. The estimated radioactive release (approximately 16 Curies) of krypton and xenon lasted about 10 minutes. The Region I office dispatched three inspectors to the site on December 17, 1979, to review the licensee's response and corrective actions. The inspectors concluded the that there had been no release of radioactive liquids to the environment; the steam generator blowdown and containment particulate high radiation alarms were caused by high background radiation from the water in the exhaust duct; the release of particulate activity was less than 0.1% of the Technical Specification limits; the release of iodine activity was less than 15% of the Technical Specification limits; the release rate of noble gases exceeded the Technical Specification limits by a factor of 5.2 for a 10 minute period (non-compliance); and the potential serious radiological consequences of the event dictated a far more timely notification to the NRC than was actually made. The inspectors also raised concerns regarding the sampling for radioactivity in the stack. The calculated dose from this event to a member of the public at the site boundary was calculated to be less than 0.5 millirem. A Notice of

Violation was issued to the licensee for exceeding the instantaneous release limit in Environmental Technical Specification.

Although the NRC response was timely and included a review of the licensee's actions, the inspectors did not document review of the adequacy of the stack monitoring relative to this event or examination of the licensee's area surveys after the event. The monitors were not designed for a vaporized steam release because vaporized steam was not typically released through the plant stack. In subsequent site radiological surveys performed by the licensee in 1980, numerous areas of localized radiological contamination were found outside the radiologically controlled area but within the owner-controlled area. Most areas of contamination were believed to be a result of this 1979 plant stack release. Additionally, once the licensee found the contaminated areas, the NRC staff documented the contamination in inspection reports but did not perform any further follow-up.

The team's review of the licensee's investigation report, dated April 1980, of this incident, identified that the licensee's dose assessment did not follow regulatory guidance. The dose assessment averaged the potential dose from particulate contamination over the skin of the whole body. The licensee's reported potential dose was 0.7 millirem. However, the dose when calculated over 1 square centimeter, which is consistent with regulatory guidance, was 6.3 rem. Based on the above, this event had the potential to result in doses approaching the occupational quarterly limit for the skin of the whole body. (The limit in effect in 1979 was 7.5 rem/quarter.)

- Multiple underground leaks of contaminated systems

From 1976 through 1980, there were several occurrences of leaks from underground pipes (steam generator blowdown, service water, and liquid waste test tank) that contributed to the tritium concentration in the local groundwater. The NRC response to these events included a review of the licensee's corrective actions. The NRC follow-up to these events and more recent follow-up to the licensee's actions for a leak in the RWST were documented in NRC Inspection Report 50-213/97-11. The results of the NRC review of the licensee's data indicated that the levels did not exceed the EPA levels for tritium in drinking water.

- Degradation of fuel cladding in 1979, 1989 and 1991

The NRC responded to the 1979 fuel cladding defects with issuance of License Amendment No. 52, which authorized changes in the fuel design and reduced the allowable peak power level in fuel rods. The safety evaluation issued with the amendment included consideration of fuel performance for the three years following the 1979 event and concluded that the changes effectively reduced the number of defects to few, if any, leaking rods.

The NRC responded to the 1989 fuel defect event with issuance of License Amendment No. 134, which limited the number of leaking fuel rods to no more than

160. It also imposed surveillance requirements to assure that throughwall fuel cladding penetrations would be promptly detected and accurately quantified. The licensee established a Fuel Recovery Program to respond to the event and sent the results of that program, such as proposed changes to the license conditions and analysis of fuel inspection findings, to the NRC.

The NRC responded to the 1991 fuel defect event with increased inspector attention to the fuel integrity monitoring program. The inspector noted that the licensee had discussed fuel integrity and the application of the associated seven-day LCO with NRC Headquarters after an indicated increase in the number of throughwall defects exceeded 160 rods following a power maneuver. However, the NRC did not perform a formal assessment of the licensee's 50.59 evaluation of the change made to the fuel monitoring program. A subsequent NRC inspection noted that preliminary results of the licensee's fuel inspection found 100 leaking rods. A follow-up report by the licensee summarizing its Fuel Recovery Program estimated 102 fuel rods had throughwall defects by the end of Cycle 16. (see Appendix A, Section 7 of this report).

- Discharge through the switchyard trench in 1989

Another example of NRC follow-up to an event was after the licensee inadvertently emptied radioactive liquid down an uncontrolled floor drain in the Spent Fuel Building during radwaste processing activities in January 1989. The drain was not labeled and the liquid discharged directly to an open trench that drained to a marshy area of the site. Radioactive material could then migrate into the discharge canal. However, freezing conditions reduced the amount of liquid that left the protected area. The licensee identified the radioactive material in February 1989 during a routine radiological survey of the site. The NRC reviewed the licensee's corrective actions and documented the actions in an inspection report (Reference NRC Inspection Report No. 50-213/89-02). However, the inspectors did not document any assessment of the licensee's corrective actions or perform independent measurements. The inspectors concluded, based on the licensee's conservative assumption that all radioactive material was released to the environment, that the resulting dose would be a small fraction of the whole body and maximum organ dose limits.

In the inspection report (50-213/89-02) cover letter, the NRC stated in part:

> *"We are very concerned that an unmonitored radiological release path has existed through Spent Fuel Building drains and that radioactive liquid entered these drains on at least one occasion. The issue of unmonitored release paths was brought to your attention in IE Bulletin 80-10. This area warrants your further consideration."*

No other NRC response or follow-up was documented at the time for this occurrence. However, this issue was reviewed by NRC inspectors in 1997. The licensee subsequently started a comprehensive review associated with IE Bulletin 80-10 (see Appendix A, Section 6 of this report).

- Reactor cavity seal failure in 1984

  The licensee had an event involving the reactor cavity seal failure in 1984 that resulted in 200,000 gallons of water discharged to the lower level of the containment building. Although there was no release to the environment, the lower level of the containment building was contaminated. The NRC reviewed the licensee's actions in response to this event in NRC Inspection Report Nos. 50-213/84-23 and 50-213/85-17. Escalated enforcement actions were taken by the NRC (EA 84-115) due to the operational aspects of this event.

Few independent measurements were documented as performed by NRC inspectors after a spill/release/event. Typically, the NRC inspectors reviewed the licensee's program for analyzing environmental and effluent samples but did not perform actual measurements. This was consistent with the NRC policy to review licensee programs instead of verifying individual measurements. However, the NRC Region I office employed a mobile laboratory that periodically visited power reactor sites and performed independent measurements as a check on licensee performance. Contamination control assessments generally relied upon the licensees' dose rate and surface contamination results. However, an independent verification, including soil samples, was performed by a specialist inspector in 1982 after alleged improper control of radioactive material on the licensee's site. The inspector concluded that the licensee's actions for remediation of contamination were complete and appeared adequate. The licensee's actions included surveying the areas, removing the contaminated soil and paving the area (NRC IR 50-213/83-02).

The NRC response and involvement from specialist inspectors has changed over the years. NRC event follow-up typically includes oversight of the licensee's corrective actions, review of dose assessments and calculations, and independent measurements for significant radioactive material releases. Recent NRC inspections performed in 1997 at Haddam Neck have provided oversight and independent measurements of the licensee's characterization surveys of the plant site and offsite areas.

2.3 NRC Enforcement Actions

The NRC enforcement history for Haddam Neck shows that enforcement actions were taken through the entire period of plant operation, continuing into the shutdown phase. Few enforcement actions were taken for spills or releases since the safety significance was very low.

The NRC enforcement history at Haddam Neck is typically representative of low-severity level violations for specific events. Radiological releases were seldom cited for escalated enforcement, because the amount of radioactivity released did not meet the NRC enforcement criteria for escalated enforcement. The releases of noble gas in excess of the Technical Specification limits were one example where the NRC cited numerous violations within a short time period (less than two years). One escalated enforcement action in 1979 was issued due to a breakdown in the radiological controls program that led to numerous violations of NRC regulations. The licensee developed a corrective action plan to upgrade the quality of the radiological controls program. After implementation of these corrective

actions, NRC inspections reflected some improvements in the program. However, several other violations were cited in the years following the implementation of the corrective actions.

The NRC team identified various plant events or conditions that potentially affected radioactive material and radiological controls over the operating period of the facility and must be considered during the licensee's site characterization effort. It is possible that some of these events or conditions are potential violations of regulatory requirements and were missed opportunities for the agency to consider and apply enforcement sanctions. These included the following:

- a modification of the radioactive waste process system in 1975, which was not adequately evaluated by the licensee in accordance with 10 CFR 50.59, resulted in radiological releases from the waste gas decay tank that were larger than they would have been if the system had been installed as originally designed and approved;

- local onsite contamination associated with various radioactive liquid waste processing activities that occurred in the open environment, though described in the design basis and covered by procedures and the Process Control Program, resulted in the migration of radioactivity to areas outside of the RCA that were not regularly surveyed or recognized as being potentially contaminated;

- systems designed as non-contaminated were continuously used after being contaminated without supporting safety evaluations and without implementing a periodic monitoring program until 1997;

- the conduct of radioactive waste handling activities in the spent fuel building in 1989 (an activity that appears to have been outside of the design basis) led to the release of radioactive materials to areas outside of the RCA, through an unmonitored and uncontrolled drain system;

- fuel cladding defects in 1979, 1989 and 1991 which increased the source term and radiation exposure hazards in the facility and resulted in the deposition of transuranic activity in many plant systems (radiological and non-radiological), consequently affecting the classification of certain radiological solid wastes from the site.

Regarding fuel cladding defects, the NRC team also determined that:

- defects in 1989 resulted in the plant exceeding a design basis limit (1% failed fuel assumed in the waste gas decay tank rupture accident), but it was not recognized or reported as such; and

- defects in 1991 contributed to the licensee modification of the fuel monitoring program, used to implement the surveillance requirements of the technical specifications, which may have been an unreviewed safety question and an unapproved change to the technical specifications.

While some of these conditions may be potential violations of agency requirements, the doses to workers and the public resulting from these situations were within the requirements of 10 CFR 20. The apparent safety significance and dose consequence to plant workers or to members of the public were low in these instances based on the NRC review of the licensee's environmental monitoring, radiological effluents, and radiation protection programs. These potential violations will be further reviewed by the NRC staff and considered for future enforcement actions in accordance with the NRC Enforcement Policy.

NRC Region I imposed a Civil Penalty of $650,000 in May 1997 for numerous violations at Haddam Neck regarding design errors during design changes, making facility changes without performing adequate safety evaluations, inadequate procedures and failure to follow procedures. NRC follow-up on the licensee's corrective actions in response to the May 1997 escalated enforcement action is continuing.

NRC enforcement was taken for a few radiological contamination events at Haddam Neck, in particular recurring events. The NRC inspectors generally documented the corrective actions taken for each violation in subsequent inspection reports. The violations were tracked as open items until the corrective actions were reviewed by NRC inspectors and verified to be implemented by the licensee. The inspectors generally found the corrective actions to be appropriate for these events. Notwithstanding this regulatory documentation process, the adequacy of the corrective actions in subsequent years was not generally revisited.

Escalated enforcement at other Part 50 licensed sites (nuclear power reactors) was not very common for the areas of radwaste design/operation, failed fuel events, radiological releases/contamination events or effluents/environmental monitoring problems. The review team believes this is consistent with the overall operation of the facility and other circumstances that are used to determine if escalated enforcement is necessary (i.e., effectiveness and timeliness of corrective actions, recurrence of events, self-identification and safety significance).

The first documented enforcement action for radiological activities at another facility was a $5,000 civil penalty (part of a larger $19,000 civil penalty) levied against Consumer's Power Company at the Palisades Plant in 1974. The enforcement action was taken relative to a discharge of gaseous waste to the plant stack, which resulted in a release to the environment. This was a Severity Level II violation.

Another enforcement action in 1974 was taken for an unmonitored release to the environment of laundry wastes at the Dresden Station. Commonwealth Edison was fined $16,000 for this violation as part of a larger $25,500 civil penalty.

Duke Power was fined $21,500 for six infractions and one deficiency when the operators at the Oconee Plant released 3 Curies of Iodine-131 into the river in 1977.

There were two escalated enforcement actions taken for violations at the Brunswick Station in 1980. Carolina Power and Light Company was fined $24,000 for a violation involving the operation of the auxiliary boiler system while it was contaminated and no safety evaluation was performed to determine the potential unmonitored release of radioactivity from the

system. The licensee was fined $89,000 for the disposal of licensed material without authorization from the NRC and release of contaminated materials for unrestricted use. This event prompted the issuance of IE Bulletin 80-10.

The operators of the Hatch Plant were fined $95,000 in 1981 for violations involving high radiation levels in an unrestricted area and release of waste oil with unknown radioactivity.

In 1983, Public Service Electric & Gas Company was fined $20,000 for a violation involving the containment gaseous, particulate and iodine monitor at the Salem Nuclear Power Plant. The monitor sample line was capped and the monitor was out of service for several days.

Sacramento Municipal Utilities District was fined $100,000 for an unplanned release from the Rancho Seco Nuclear Power Station in 1986. A matching fine was issued to the operators of the San Onofre Plant (Southern California Edison) for various violations, including the release of radioactive materials to an unrestricted area. In 1991, the Power Authority of the State of New York was fined $137,500 for violations, including an unplanned release of radioactive materials to an unrestricted area.

More recently, Public Service Electric & Gas Company was given various violations (Severity Level III) for an operational event in 1996 that released 25 gallons of steam and water to the environment from the liquid radwaste system at the Hope Creek Nuclear Power Plant. The release contaminated buildings, personnel and vehicles on the site. At least one contaminated vehicle was removed from the site without a radiological survey. The total release was estimated to contain approximately 85 millicuries. GPU Nuclear Corporation was charged with five violations (highest Severity Level of IV) for events which included an unplanned release due to a human performance error in 1997. Water from a radioactively contaminated system was used to flush another clean system component, which resulted in a minor release of radioactivity to the environment. This was not the first unplanned release to the environment at the facility in a short period of time, and even though the potential doses to the public were well below the regulatory limits, the NRC issued the violation to express the concern regarding repeated problems.

Note: The increased civil penalty values that have occurred over time are most often due to the changes in the NRC enforcement policy that have increased the base civil penalty for escalated enforcement.

Conclusions

NRC follow-up to radiological events at Haddam Neck varied based on safety and operational significance. The major radiological events were documented in inspection reports. None of these cases resulted in exposure to the public in excess of the annual regulatory limits specified in 10 CFR 20. However, events in 1979 that resulted in approximately 40 discrete areas of the site with fission product activity could have resulted in skin contamination with doses near the quarterly occupational limits in 10 CFR Part 20. Review of licensee's programs was the primary method used to determine the adequacy of licensee data, but some independent measurements were performed to verify that the licensee's programs and processes were accurate. Response to significant events has improved in the 1990s and

specialist inspectors are more likely to be involved in the NRC follow-up and evaluation of the licensee's corrective actions to prevent recurrence. NRC inspection policy and procedures do not provide criteria for NRC follow-up response to radiological events that have limited safety significance. The amount of follow-up is at the discretion and direction of NRC management and is usually dependent upon inspection priorities and safety significance.

Enforcement actions at the Haddam Neck plant were generally consistent with the existing policy of the NRC and practices that evolved over time. Enforcement was taken for some radiological events, including recurring problems, however, the enforcement actions were low level and not escalated. This is typical for events at other nuclear power reactors, but escalated enforcement action was taken in some cases at other power reactors in the past. These cases must be reviewed in detail to determine the enforcement criteria that was applied and the civil penalties that were imposed upon the operators of the facilities. Escalated enforcement has been more common since 1980. Additionally, escalated enforcement is usually taken when an operational error or a failure to follow procedures is also cited with an unplanned radioactive release.

The NRC Historical Review Team noted a number of past licensee actions that may not have been in compliance with NRC requirements existing at the time. These items will be further reviewed by the NRC staff to determine if enforcement actions are appropriate. This review will consider the relationship of the issues to the current licensed activities at the site and the need for corrective actions to prevent recurrence.

Table B
Enforcement Actions for Areas of Concern

Year	Enforcement Action	Severity	Description
1969	Non-compliances (2)	N/A	Release of radioactive isotopes to an unrestricted area (200 gallons to the discharge canal); 700 millirem/hour radiation field at fence line
1970	Non-compliances (2)	N/A	Inadequate surveys; stack recorder not inking
1971	Non-compliance	N/A	Restricted area dose rates above limit of 100 millirem in a 7 day period
1973	Non-compliance	N/A	Monthly tests of containment air filtration system not performed
1975	Infractions (2)	N/A	Failure to survey in containment
1976	Deficiencies (2)	N/A	Failure to perform a gamma isotopic analysis of a weekly gaseous particulate filter sample
1979	Infractions (9); $27,500 CP management mtg.	Escalated	Numerous violations/weaknesses in radiological controls program and release through the plant stack
1980	Infractions (3)	N/A	Various unplanned noble gas releases in excess of Tech. Spec. limits
1980	Violations (3)	Level V	Environmental monitoring program deficiencies
1981	Violation	Level IV	Radioactive material transferred as scrap to an non-licensed individual
1984	Violation	Level IV	Improper radwaste processing
1984	Escalated; $80,000 CP	Level II	Cavity seal failure, release of contaminated water to the containment floor
1984	Escalated; No CP	Level III	Radiation dose for worker exceeded regulatory limits
1986	Violation	Level IV	Improper use of radwaste compactor spread contamination to outdoor areas
1986	Violations (8)	Level IV	Radwaste deficiencies
1986	Escalated; $50,000 CP	Level III	Radiation dose for worker exceeded regulatory limits
1995	Escalated	Level III	RHR system
1996	Escalated (Pending)		Unplanned exposures to workers in the fuel transfer canal
1997	Escalated, $650,000 CP	Level II, III, IV	Design control issues
1997	Escalated; No CP	Level III	Corrective action problems, safety evaluations